ARIANESPACE AND STARSEM TO ORBIT AMOS 2

To meet the requirements of its customer, Israel Aircraft Industries Ltd., Arianespace and Starsem have decided to orbit the AMOS 2 satellite on a Soyuz launcher in agreement with Israeli operator Spacecom Ltd.

The launch of AMOS 2, originally planned on an Ariane launcher, will be performed by the Soyuz vehicle from the Baikonur Cosmodrome in Kazakhstan. This switch illustrates the launcher family policy developed by Arianespace and Starsem to best respond to their clients' needs.

Arianespace launched Israel's first telecommunications satellite, AMOS 1, in 1996.

The AMOS 2 mission will mark the 12th flight performed by Starsem, which has been responsible for Soyuz commercialization and operation on the international marketplace since 1996. Starsem's shareholders are Arianespace, EADS, the Russian Aviation & Space Agency and the Samara Space Center.

The AMOS 2 satellite will be co-located with AMOS 1 at 4° West and will provide additional high-powered capacity over Europe, the Middle East and the east coast of the U.S.A.

AMOS 2 was designed and built by MBT- Space Division of Israel Aircraft Industries (IAI). It will be equipped with twenty eight 36 Mhz Ku-Band high power channels. The satellite state of the art design enables high operational flexibility in allocation of the transponders capacity between its three coverage areas.

MBT Space Division is the Israeli national space center with 20 years experience. It's main products are observation and communication satellites and their associated Ground Control Stations.

Operated by Spacecom, the AMOS 2 satellite will provide transponders' capacity to DBS service providers, cable TV companies and content providers as well as Internet and data transmissions for regional ISPs, VSAT networks and various organizations.

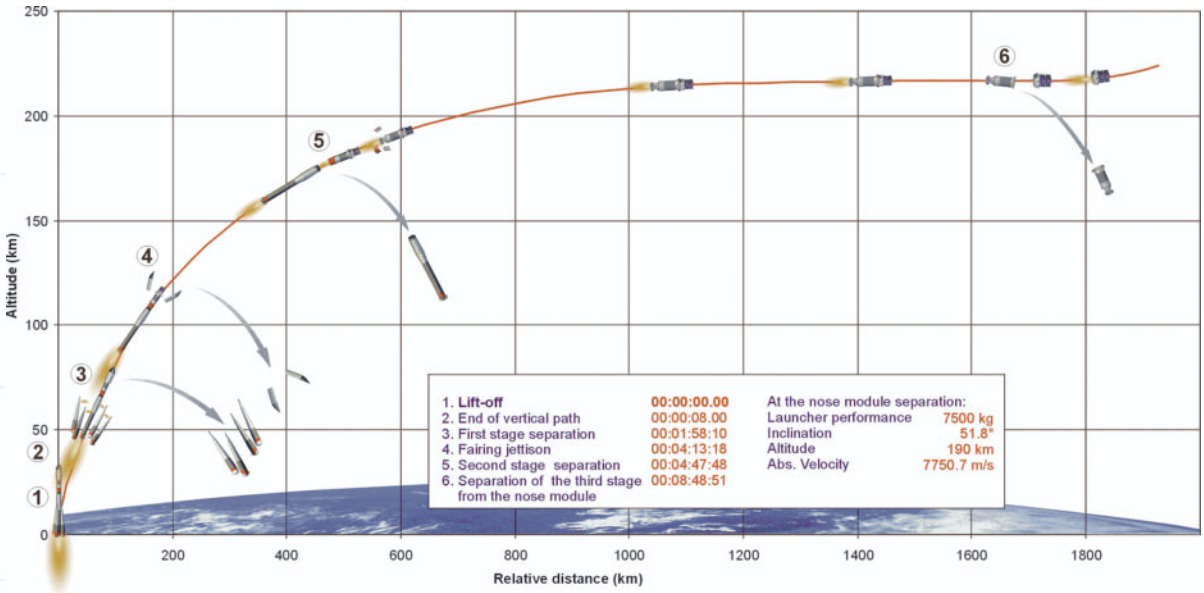
Spacecom Ltd. is the marketer and service provider of the AMOS 1 and AMOS 2 satellites.
Spacecom is a joint venture of Israel Aircraft Industries Ltd. (IAI), Eurocom Group, General Satellite Services Co. (GSSC), and Mer Services Group Ltd.

MISSION DESCRIPTION

The launch of AMOS 2 will be performed from the Baikonur cosmodrome, Launch Pad #6.
The lift-off is scheduled **on the night of December 27 to 28, 2003.**
For the AMOS 2 mission, the launch window is **21:30:00 ± 1 s (UTC).**
10:30 pm (Paris Time), 11:30 pm (Tel-Aviv Time), on December 27
02:30 am (Baikonur Time), on December 28

Mission main phases:

- **1** Three-stage vehicle ascent phase and injection of the Nose Module to an unclosed orbit by the Soyuz Launch Vehicle – Nose Module separation from the third stage



- **2** First Fregat burn: injection to the circular parking orbit
- **3** Coast phase on the parking orbit
- **4** Second FREGAT burn at ascending node: injection to the intermediate transfer orbit, first inclination reduction
- **5** Coast phase on the intermediate transfer orbit
- **6** Third FREGAT burn at descending node: injection to the GTO, second inclination reduction
- **7** Orientation and three-axis stabilization maneuvers – Spacecraft separation
- **8** FREGAT maneuver to be placed onto a safe orbit

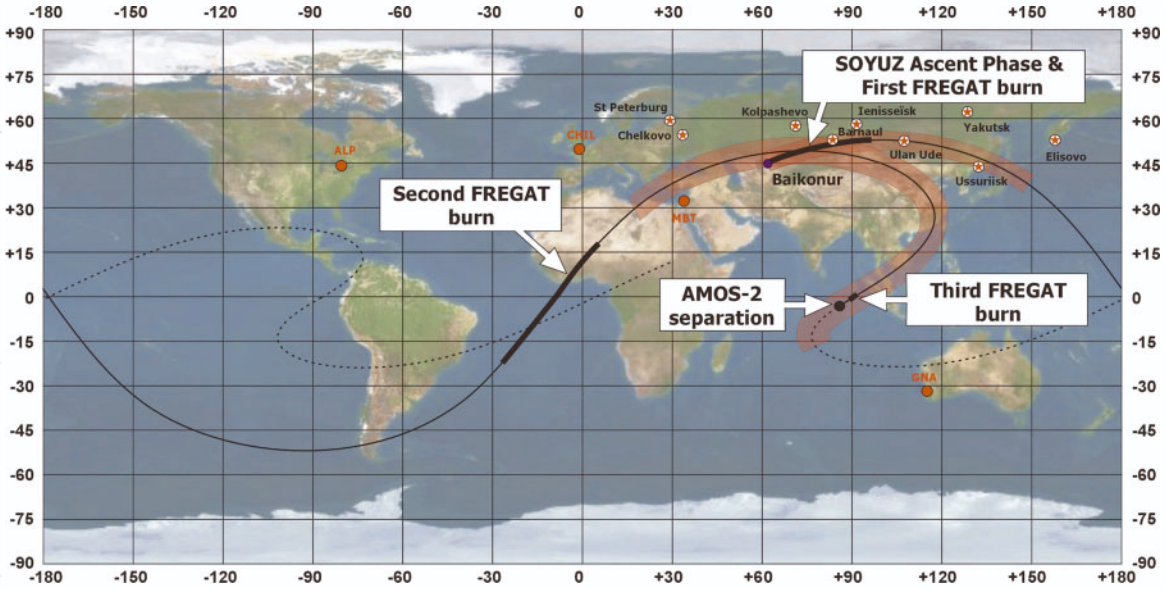
The Russian ground tracking network will be used to track the LV and to receive telemetry during the three-stage vehicle ascent phase and during Fregat flight leading to injection and separation of AMOS 2.

Mission duration:

The nominal mission duration (from lift-off to spacecraft separation) is ~ **6 hours 46 minutes 47 seconds.**

Fregat de-orbitation

After spacecraft separation, the Fregat upper stage is injected onto a safe orbit, using one burn of its attitude control thrusters.



Separation orbit – Orbital parameters requirements:

Osculated orbital parameters in the Greenwich system frozen at lift-off	Unit	Value	Accuracy (3 σ)
Perigee radius	km	10,785	50
Apogee radius	km	42,166	140
Inclination to equator	deg	23.63	0.09
Longitude of ascending node	deg	10.25	0.33
Argument of perigee	deg	-0.53	0.30

SOYUZ LAUNCH VEHICLE

The Soyuz launch vehicle family has provided reliable and efficient launch services since the birth of the space program. Vehicles in this family, which launched both the first satellite and first man into space, have been credited with more than 1680 launches to this date. Today, this vehicle is used for manned and unmanned flights to the International Space Station and commercial launches managed by Starsem.

The Soyuz configuration introduced in 1966 has been the workhorse of the Soviet/Russian space program. As the only manned launch vehicle in Russia and the former Soviet Union, the Soyuz benefits from excellent standards in both reliability and robustness.

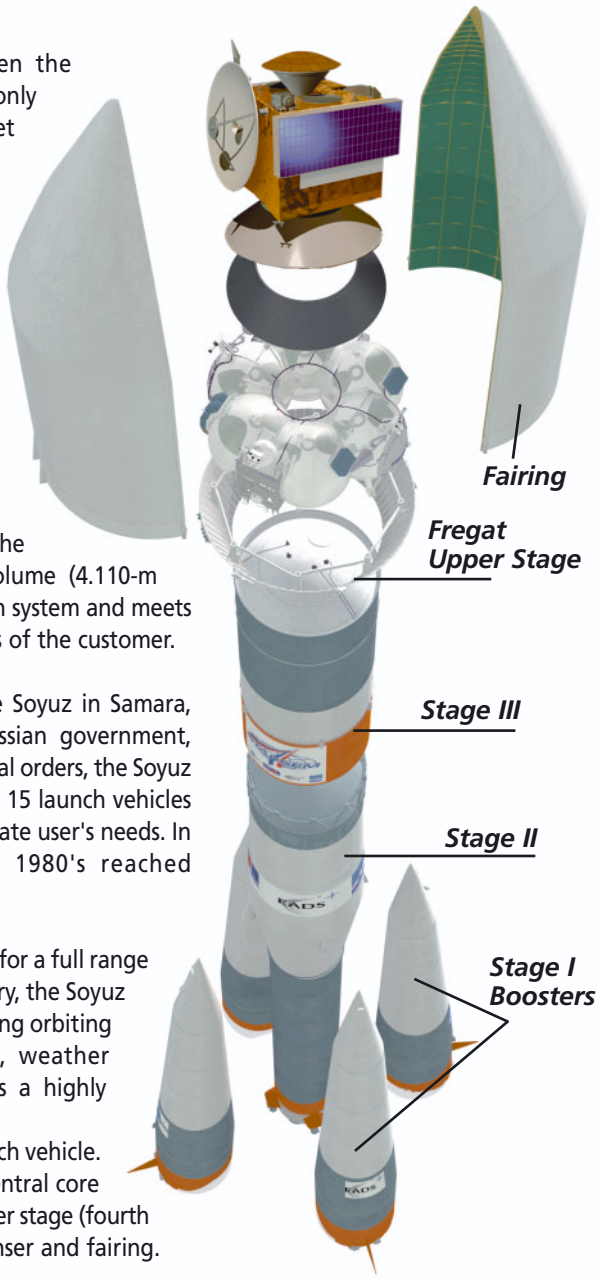
The addition of the restartable Ikar upper stage to the three-stage Soyuz in 1999 allowed Starsem to launch 24 satellites of the Globalstar constellation in 6 launches.

Following this success, Starsem introduced the flexible, restartable Fregat upper stage with significantly more propellant capacity than the Ikar, thus opening up a full range of missions (LEO, SSO, MEO, GTO, GEO, and escape).

In 2005, Starsem will introduce an upgraded version of the Soyuz launch vehicle, which adds increased payload volume (4.110-m fairing) and flexibility (digital control system) to this launch system and meets both the performance and payload accommodation needs of the customer.

The Samara Space Center continues to mass-produce the Soyuz in Samara, Russia. As a result of continued demand from the Russian government, International Space Station activity, and Starsem's commercial orders, the Soyuz is in uninterrupted production at an average rate of 10 to 15 launch vehicles per year with a capability to rapidly scale up to accommodate user's needs. In fact, peak production of the Soyuz in the early 1980's reached 60 vehicles per year.

The Soyuz is a reliable, efficient, and cost-effective solution for a full range of missions from LEO to Mars. In its unequalled flight history, the Soyuz has already performed almost every mission profile, including orbiting satellites for telecommunications, Earth observation, weather monitoring, scientific missions and manned flights. It is a highly responsive and flexible launch vehicle.
The Soyuz currently offered by Starsem is a four-stage launch vehicle. The vehicles each consist of four boosters (first stage), a central core (second stage), a third stage, and the restartable Fregat upper stage (fourth stage). Each vehicle also includes a payload adapter/dispenser and fairing.

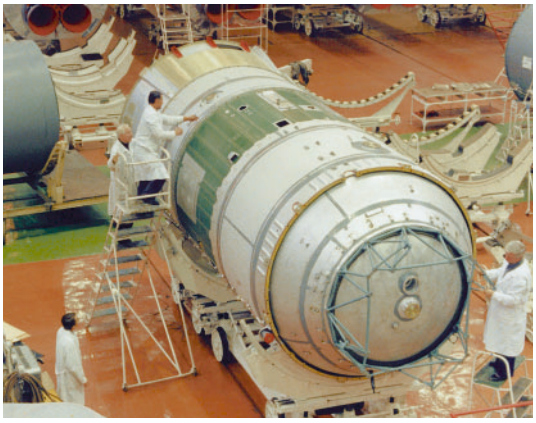


The Boosters (first stage)

The four boosters are assembled around the central core and are tapered cylinders with the oxidizer tank in the tapered portion and the kerosene tank in the cylindrical portion.
The booster's RD-107A engines are powered by liquid oxygen and kerosene, the same propellants which are used on each of the lower three stages. Each engine has four combustion chambers and nozzles. Three-axis flight control is carried out by aerofins (one per booster) and movable vernier thrusters (two per booster).
Following liftoff, the boosters burn for 118 seconds and are then discarded. The separation time is determined by comparing the velocity with a predefined value. Thrust is transferred through a ball joint located at the top of the cone-shaped structure of the booster, which is attached to the central core by two rear struts.

Central Core (second stage)

The central core is similar in construction to the four boosters, with a hammer-head shape to accommodate the boosters. A stiffening ring is located at the interface between the boosters and the core. This stage has a RD-108A engine with four combustion chambers and nozzles and four vernier thrusters. The verniers are used for three-axis flight control once the boosters have separated. The core stage nominally burns for 290 seconds. Ignition of the central core and boosters occurs at an intermediate level of thrust on the launch pad 20 seconds before liftoff in order to monitor engine health parameters before the engines are throttled up and the vehicle leaves the pad.



Third Stage

The third stage is linked to the central core by a latticework structure. Ignition of the third stage's main engine occurs approximately 2 seconds before shutdown of the central core. The third stage engine's thrust directly separates the stage from the central core. In between the oxidizer and fuel tanks is an intermediate bay where avionics systems are located. This stage uses a RD-0110 engine with four combustion chambers and nozzles. Four vernier nozzles provide three-axis flight control. The third stage engine nominally burns for 240 seconds. After engine cut-off and separation of the fourth stage, the third stage performs an avoidance maneuver by opening an outgassing valve in the liquid oxygen tank.

Fregat Upper Stage (fourth stage)

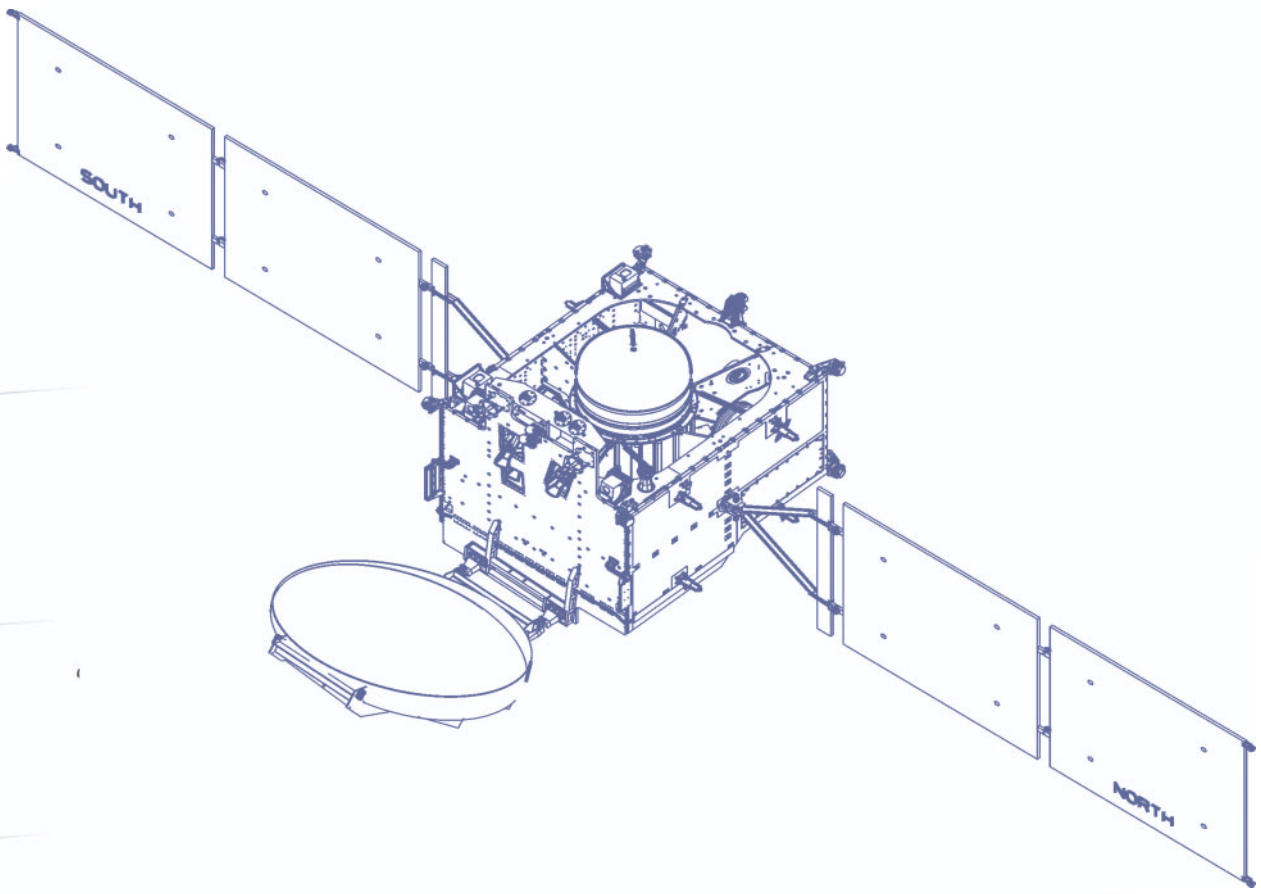
Flight qualified in 2000, the Fregat upper stage is an autonomous and flexible upper stage that is designed to operate as an orbital vehicle. It extends the capability of the lower three stages of the Soyuz vehicle to provide access to a full range of orbits (MEO, SSO, GTO, escape). In order to provide the Fregat with high initial reliability, several flight-provensubsystems and components from previous spacecraft and rockets are incorporated into the upper stage. The upper stage consists of 6 spherical tanks (4 for propellant, 2 for avionics) arrayed in a circle, with trusses passing through the tanks to provide structural support. The stage is independent from the lower three stages, having its own guidance, navigation, control, tracking, and telemetry systems.

The stage uses storable propellants (UDMH/NTO) and can be restarted up to 20 times in flight, thus enabling it to carry out complex mission profiles. It can provide the customer with 3-axis stabilization or spin-up of their spacecraft.

Payload Accommodation

The current Soyuz flies the S-type fairing, with external diameter of 3.715-m and a length of 7.700-m. The Fregat upper stage is encapsulated in the fairing with the payload and a payload adapter/dispenser. Starsem has already developed a series of adapters and dispensers, which may be used directly by the customer. Starsem can also carry out development of a new adapter or dispenser tailored to the customer's spacecraft.

THE AMOS 2 SATELLITE



CUSTOMER	SPACECOM	
Prime contractor	IAI/MBT Space Division	
Mission	Direct to home video broadcasting, Internet and Data Transmissions	
Mass	Total mass at lift-off	1,370 kg
	Dry mass	646 kg
Stabilization	3 axis stabilized	
Dimensions		2.7 x 2.06 x 2.38 m
	Span in orbit	11.03 m
Payload	22 out of 28 active 36 Mhz Ku band channels	
On-board power	1,900 W (at end of life)	
Life time	12 years	
Orbital position	4° West (Co-located with AMOS 1)	
Coverage area	Middle East, Europe, East Coast of the U.S.A	

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LAUNCH CAMPAIGN

After the analysis and production activities have been completed and the spacecraft arrives at the Baikonur airport, the launch campaign begins. The following outlines the key events in the AMOS 2 launch campaign (L = Liftoff):

L-6 weeks:
Launch campaign activities begin at the Cosmodrome; AMOS 2 arrives at the Cosmodrome and begins spacecraft preparation activities in Starsem's PPF

L-4 weeks:
Filling of spacecraft begins

L-18 days:
Preparation and assembly of the launch vehicle lower three stages begins

L-18 days:
Combined operations begin in UCIF. These activities mate the spacecraft to the adapter and Fregat upper stage, followed by encapsulation with the fairing

L-8 days:
Upper composite (spacecraft + adapter + Fregat + fairing) is transferred to assembly facility near the launch pad where it is mated to the lower three stages of the launch vehicle

L-6 days:
The Transfer Readiness Review ensures the Soyuz and its payload are ready for final launch pad activity and launch

L-5 days:
The fully assembled launch vehicle is transferred to the pad and erected in the vertical position; Check out and countdown rehearsal for the lower 3 stages of the vehicle takes place

L-2 days:
Countdown rehearsal for the customer's spacecraft and the Fregat upper stage

L-8 hours:
Final countdown begins; Systems checks on Soyuz begin

L-5 hours:
Systems checks begin on Fregat upper stage

L-4 h20m:
Launch vehicle filling authorization review

L-4 hours:
Launch vehicle fueling begins

L-30 minutes:
Removal of service platform

L-2m35s:
Pressurization of propellant tanks

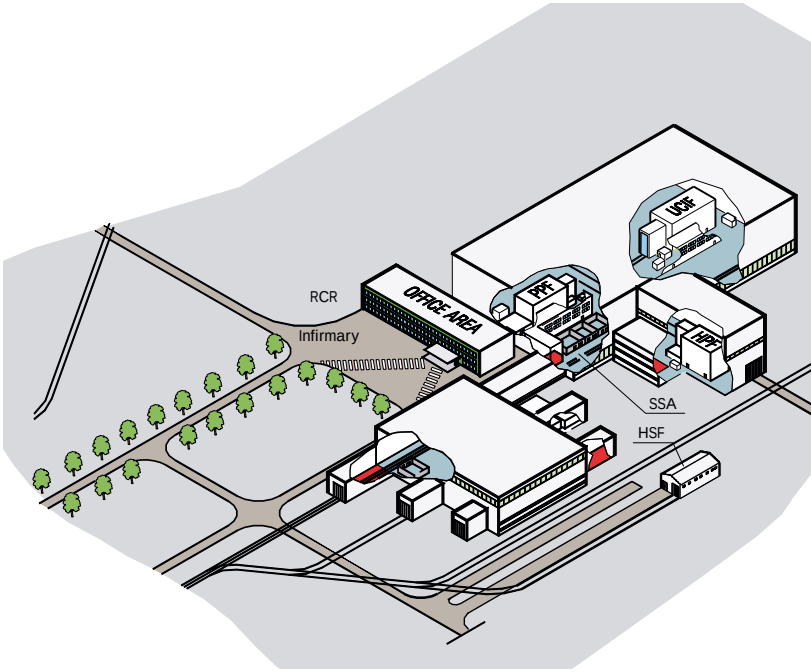
L-45 seconds:
Transfer to on-board power supply

L-20 seconds:
Ignition of booster and core engines at intermediate thrust level

L-0:
Liftoff!

STARSEM BAIKONUR FACILITIES

Starsem has adapted, modified, developed, and built dedicated facilities at the Baikonur Cosmodrome which allow our customers access to state-of-the-art facilities for their launch campaign.
Central to these facilities are the three Class 100,000 clean rooms used for the complete integration checkout, test, and fueling of our customer's spacecraft.



Site 112

Starsem's facilities are located primarily in two areas of the Cosmodrome: Site 112 and Site 31. Site 112 is the location of the assembly and integration facility for the former Energia launch vehicle. This facility (MIK 112) houses Starsem's dedicated clean rooms and is the location where our customer's spacecraft are prepared, fueled, and eventually mated to the Fregat upper stage and encapsulated in the fairing. Our customer's offices are also located in this facility.

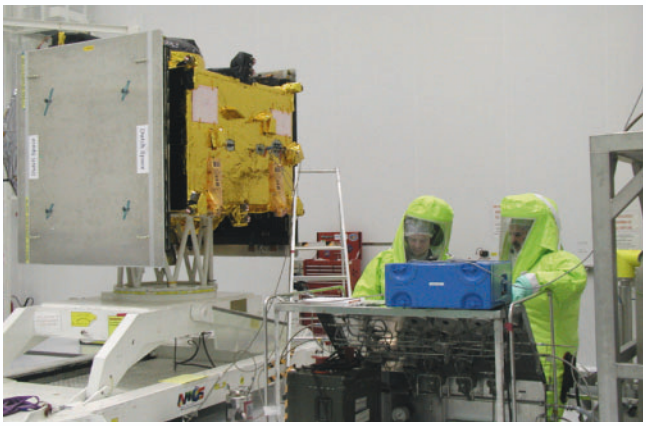
Built in 1998, Starsem's 1158-m² of Class 100 000 clean rooms ensure our customers with international standard facilities for the preparation of their spacecraft.

This allows our customers to have their spacecraft in a controlled environment from spacecraft unpacking through encapsulation. Portable and fixed ventilation systems ensure the thermal conditions of the spacecraft until launch.

Failsafe backup power supplies are available in all clean rooms to protect sensitive hardware during processing activities. Dedicated networks allow voice and data exchange between the clean rooms and other facilities. An independent, redundant satellite communications system provides high data rate connections between customers and their home base.

The Payload Processing Facility (PPF)

The PPF features a 286 m² high bay for the processing of our customer's spacecraft. This facility has two independent 70 m² control rooms to permit parallel operations and personnel and equipment airlocks to ensure the integrity of conditions in the processing area.



The Hazardous Processing Facility (HPF)

The HPF high bay covers a surface of 285 m^2, and is designed for spacecraft filling activities and pressurization of tanks. The HPF is designed to accommodate bipropellant spacecraft (e.g. MMH / N2O4). The facility has airlocks and an on-site control room. A remote control room in the customer office area with a dedicated data transmission system, intercoms, and video monitors ensures maximum safety for our customer's launch teams. Spacecraft propellants are stored in the controlled and monitored Hazardous Storage Facility, located next to MIK 112.

Site 31

Site 31 includes the launch pad, Assembly and Integration facility for the launch vehicle (MIK 40), and administrative buildings. After encapsulation, our customer's spacecraft is transported to MIK 40 under a controlled environment to be mated to the rest of the launch vehicle in MIK 40. Following integration, the vehicle is rolled out to the launch pad, and launched on yet another successful mission.

The Upper Composite Integration Facility (UCIF)

Spacecraft mating with the Fregat upper stage is performed in this 587 m2 high bay, along with fairing encapsulation. The facility has equipment and personnel airlocks and a on-site control room. The remote control room in the customer office area can also be used to monitor activities in the UCIF. The data network allows the customer to carry out spacecraft testing via direct links with EGSE installed in the PPF control room.

STARSEM'S FOUNDING COMPANIES

As the Soyuz Company, Starsem brings together four of the world's leading space organizations:

EADS (35%)

The European Aeronautic Defence and Space Company (EADS) is the world's third largest aerospace and defense company, created through the merger of France's Aerospatiale and Matra, Spain's CASA, and Germany's DASA. EADS is one of the world's leading jetliner manufacturers (Airbus), and number one in helicopters (Eurocopter) and commercial launch vehicles (Ariane). It also is among the world leaders in the production of satellites (Astrium), military aircraft (A400M and Eurofighter) and defense systems. EADS is the main industrial architect and stage integrator of Ariane launchers, and holds the position as Europe's n°. 1 company in space transportation systems. It has the equivalent of more than 200 years operational in-orbit service experience with its own telecommunications satellites, while it designs and produces both military and civil spacecraft for Earth observation/reconnaissance.

Arianespace (15%)

Arianespace is the international leader in commercial launch services, and today holds more than 50 percent of the world market for satellites launched to the geostationary transfer orbit (GTO).
From its creation in 1980 as the first commercial space transportation company, Arianespace has successfully performed over 160 launches and signed contracts for more than 250 payloads with some 61 operators/customers. Arianespace oversees the marketing and sales, production and operation of Ariane launch vehicles. Arianespace has placed the Ariane 5 launcher into commercial service to meet the market requirements of today and tomorrow. This heavy-lift vehicle is perfectly tailored to the increasingly diversified demand for service - including heavier and larger satellites, a wider range of orbits and combined missions. Based in Evry, France, Arianespace has 44 European corporate shareholders.

Russian Aviation and Space Agency (25%)

The Russian Aviation and Space Agency (ROSAVIACOSMOS) is the central body of the federal executive authority defining the Russian Federation's national policy in the field of space research and exploration. The agency also performs interdisciplinary coordination of national scientific and application space programs. It was created in February 1992 by a decree issued by the President of the Russian Federation. ROSAVIACOSMOS's responsibilities include: development and implementation of Russian national space policy; acting in the capacity of government customer in the development of scientific and application space systems, facilities and equipment; establishing international cooperation and collaboration in space research, and organization/coordination of commercial space programs.
Operations under ROSAVIACOSMOS responsibility include more than 400 aeronautic and space companies and organizations.

The Samara Space Center (25%)

The Samara Space Center "TsSKBProgress" was created by a Russian Presidential decree in 1996 by combining the TsSKB Central Samara Design Bureau and the "Progress" production plant. The Samara Space Center is one of the world leaders in the design of launchers, spacecraft and related systems. Its history goes back to the start of the space program in 1959 when a branch of the Moscow OKB-1 design bureau was established in the city of Kuibyshev (now known as Samara).